

# Growth Failure in Children with Chronic Kidney Disease

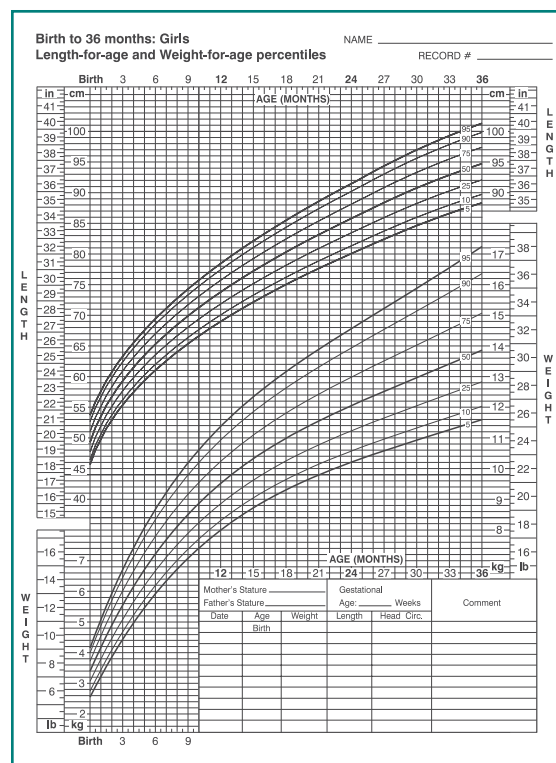
What is growth failure in children with chronic kidney disease (CKD)?

Growth failure is a complication of CKD in which children do not grow as expected. When a child is below the third percentile—meaning 97 percent of children the same age and gender are taller—he or she has growth failure.<sup>1</sup> CKD is kidney disease that does not go away with treatment and tends to get worse over time.

Health care providers use charts to monitor the growth of children with CKD and look for signs of growth failure. Growth charts for children use percentiles to compare a particular child's height with the height of children the same age and gender. For example, a child whose height is at the 50th percentile on a growth chart means half the children in the United States are taller than that child and half the children are shorter.

About one-third of children with CKD have growth failure.<sup>1</sup> Children diagnosed with CKD at a younger age

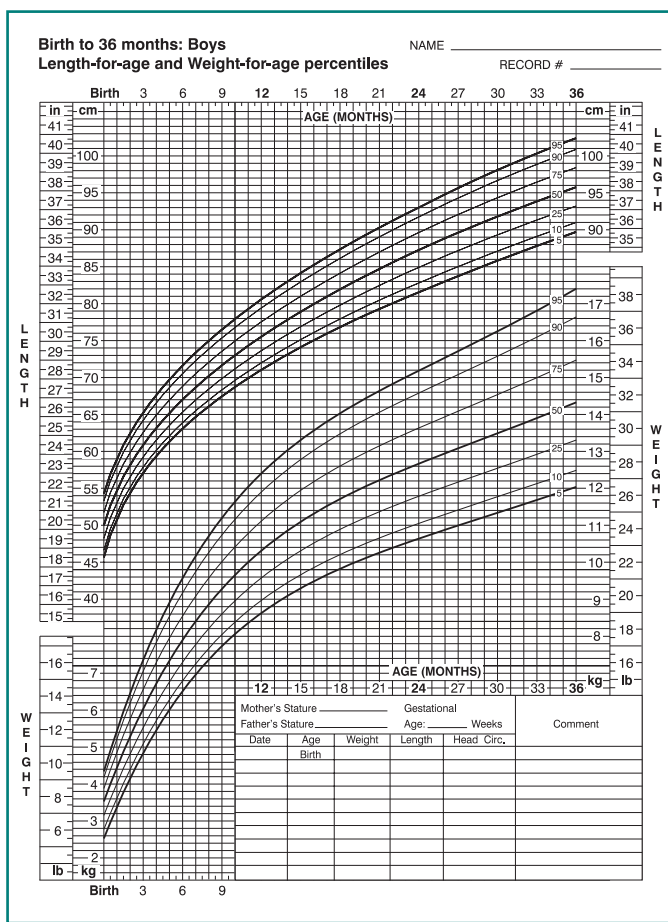
- have a higher chance of developing growth failure
- have more health issues related to growth failure and CKD



Growth chart for girls 0 to 36 months old

Source: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000). The Centers for Disease Control and Prevention. [www.cdc.gov/growthcharts](http://www.cdc.gov/growthcharts).

<sup>1</sup>Janjua HS, Mahan JD. Growth in chronic kidney disease. *Advances in Chronic Kidney Disease*. 2011;18(5):324–331.

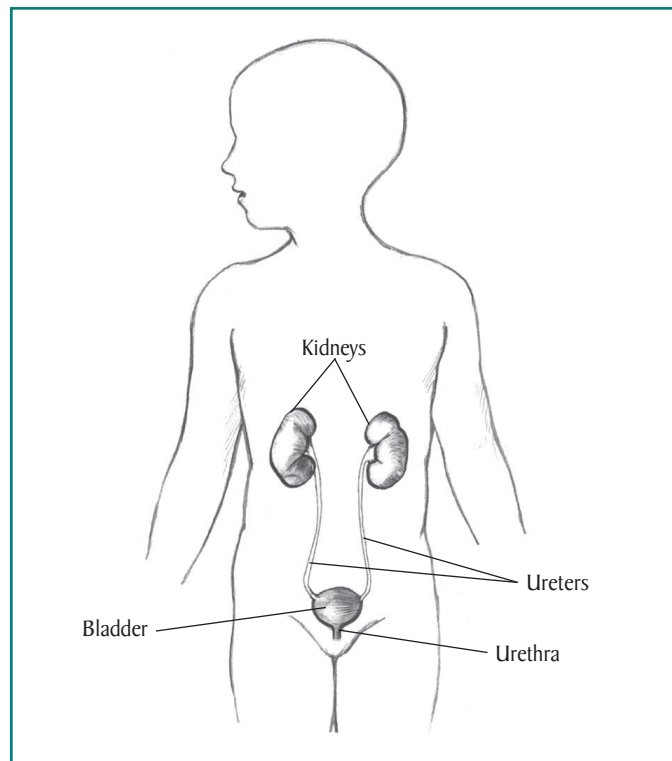


### Growth chart for boys 0 to 36 months old

*Source:* Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000). The Centers for Disease Control and Prevention. [www.cdc.gov/growthcharts](http://www.cdc.gov/growthcharts).

## What are the kidneys and what do they do?

The kidneys are two bean-shaped organs, each about the size of a fist. They are located just below the rib cage, one on each side of the spine. Every day, the two kidneys filter about 120 to 150 quarts of blood to produce about 1 to 2 quarts of urine, composed of wastes and extra fluid. Children produce less urine than adults and the amount produced depends on their age. The urine flows from the kidneys to the bladder through tubes called ureters. The bladder stores urine. When the bladder empties, urine flows out of the body through a tube called the urethra, located at the bottom of the bladder.



The urine flows from the kidneys to the bladder through tubes called ureters.

## What causes growth failure in children with chronic kidney disease?

Researchers have found that many factors cause growth failure in children with CKD. In addition to removing wastes and extra fluid from the blood, the kidneys perform important functions for a child's growth. Understanding normal kidney function and growth helps families understand what causes growth failure in children with CKD.

Normal kidney function helps maintain the

- balance of nutrients and minerals, such as calcium and phosphorus, in the blood. These minerals are essential for normal bone growth. The kidneys use a hormone called calcitriol, a form of vitamin D, to help bones absorb the right amount of calcium from the blood. The kidneys also remove extra phosphorus, helping balance phosphorus and calcium levels in the blood.
- body's ability to use growth hormone. Growth hormone is necessary during childhood to help bones grow and stay healthy. The pituitary gland naturally produces growth hormone, which acts as a messenger to help the body grow. Growth hormone tells the liver to produce another hormone, called insulin-like growth factor, that travels to muscles, organs, and bones and tells them to grow.
- correct levels of erythropoietin in the body. Erythropoietin is a hormone that helps bone marrow make red blood cells.
- proper balance of sodium, also called salt; potassium; and acid-base levels in the blood. Acid-base balance refers to the amount of acid in the blood.

Damaged kidneys can slow a child's growth by

- causing mineral and bone disorder, which occurs when
  - vitamin D is not turned into calcitriol, which starves the bones of calcium.
  - phosphorus levels rise in the blood and draw calcium out of the bones and into the blood, causing the bones to weaken.
- creating an imbalance of sodium, potassium, and acid-base levels in the blood, also called acidosis. When blood is not balanced, the body slows growth to focus energy on restoring the balance.
- decreasing appetite. A child with CKD may not be hungry, or he or she may not have the energy to eat, which may lead to poor nutrition and slower growth.
- decreasing the production of erythropoietin. When erythropoietin levels are low, a child may develop anemia—a condition that develops when the blood does not have enough healthy red blood cells to carry oxygen to cells throughout the body. Anemia can cause growth to slow or stop.
- making an abnormally large amount of urine, called polyuria, which disrupts the body's fluid balance. A child with polyuria loses minerals as well. The body slows growth to make up for the lost fluid and minerals.
- preventing the body from correctly using growth hormone. When the kidneys are damaged, waste builds up in the blood and the body does not properly process growth hormone.

## How is growth failure treated in children with chronic kidney disease?

Health care providers treat growth failure in children with CKD with

- changes in eating, diet, and nutrition
- medications
- growth hormone therapy

Most children with growth failure grow to about one-third of their adult height within the first two years of life; therefore, it is important to start treatment for growth failure early.<sup>1</sup>

### Eating, Diet, and Nutrition

Children with CKD may lose their appetite or lack the energy to eat. To treat growth failure in children, a health care provider may recommend dietary changes, such as

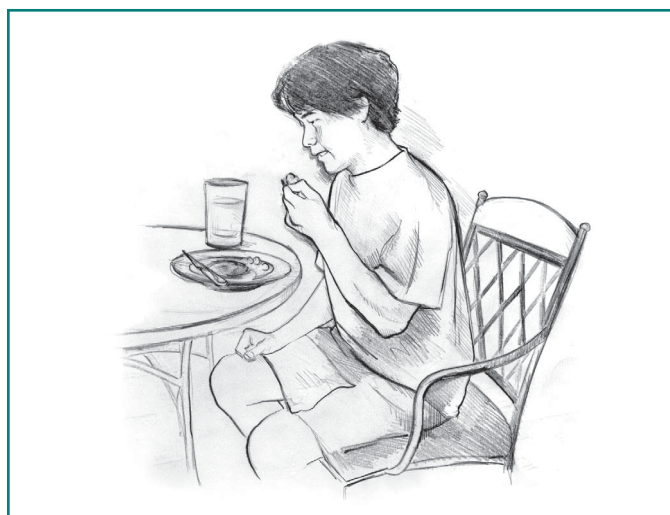
- adding calcium. Children with CKD should get the recommended level of calcium for their age from their diet or from calcium supplements.
- monitoring liquids. Balancing the child's liquid intake based on his or her kidney disease is important. Some children will need to increase liquid intake, while other children will need to restrict liquid intake.
- limiting phosphorus. Children with CKD may need to limit phosphorus intake if they have mineral and bone disorder.
- monitoring protein. Children with CKD should eat enough protein for growth; however, they should avoid high protein intake, which can put an extra burden on the kidneys.
- monitoring sodium. The amount of sodium children with CKD need depends on the stage of their kidney disease, their age, and sometimes other factors. The health care provider may recommend either limiting or adding sodium, often from salt, to the child's diet.
- adding vitamin D. Children who do not get enough vitamin D through diet may need to take vitamin D supplements.

To help ensure coordinated and safe care, parents and caregivers should discuss the use of complementary and alternative medical practices, including the use of dietary supplements, with the child's health care provider. Read more at [www.nccam.nih.gov](http://www.nccam.nih.gov).

Some children will use a feeding tube to receive all their nutrition. A feeding tube is a small, soft plastic tube placed through the nose or mouth into the stomach. The child will receive supplements through the tube to provide a full supply of fluid and nutrients to help him or her grow and develop. Feeding tubes are most often used in infants; however, sometimes older children and adolescents benefit from them as well.

Encouraging children to develop healthy eating habits can help prevent poor nutrition and promote healthy growing. The health care team will work with parents or caretakers to develop a healthy diet tailored to meet the needs of their child.

Read more about diet and kidney disease in *Nutrition for Chronic Kidney Disease in Children* at [www.kidney.niddk.nih.gov](http://www.kidney.niddk.nih.gov).



Encouraging children to develop healthy eating habits can help prevent poor nutrition and promote healthy growing.

## Medications

A health care provider may prescribe medications that can help correct the underlying problems causing growth failure.

- A health care provider may prescribe phosphate binders when phosphorus levels in the blood rise and interfere with bone formation and normal growth. In the intestine, the medications bind, or attach, to some of the phosphorus found in food, causing the phosphorus to move through the intestine without being absorbed and exit the body in the stool. This process can decrease blood phosphorus levels and increase blood calcium levels. Phosphate binders come as chewable tablets, liquids, capsules, and pills.
- A health care provider may prescribe alkaline agents such as sodium bicarbonate to restore the acid-base balance in a child with acidosis.
- Synthetic erythropoietin is a man-made form of erythropoietin given by injection to treat anemia.

## Growth Hormone Therapy

When a health care provider diagnoses a child with CKD and the child begins to show signs of growth failure, the health care provider may prescribe daily human growth hormone injections. The injections are a man-made growth hormone that mimics the natural hormone found in the body. Researchers have shown that using growth hormone therapy is effective in helping children reach normal adult height.

Read more in *Treatment Methods for Kidney Failure in Children* at [www.kidney.niddk.nih.gov](http://www.kidney.niddk.nih.gov).

## Points to Remember

- Growth failure is a complication of chronic kidney disease (CKD) in which children do not grow as expected.
- Health care providers use charts to monitor the growth of children with CKD and look for signs of growth failure.
- Researchers have found that many factors cause growth failure in children with CKD.
- Health care providers treat growth failure in children with CKD with
  - changes in eating, diet, and nutrition
  - medications
  - growth hormone therapy
- Encouraging children to develop healthy eating habits can help prevent poor nutrition and promote healthy growing.
- The health care team will work with parents or caretakers to develop a healthy diet tailored to meet the needs of their child.
- When a health care provider diagnoses a child with CKD and the child begins to show signs of growth failure, the health care provider may prescribe daily human growth hormone injections.



## Hope through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) conducts and supports research to help people with kidney diseases, including children. The NIDDK, in collaboration with the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, and the National Heart, Lung, and Blood Institute, funded the formation of a consortium that includes two Clinical Coordinating Centers, which serve about 50 sites in the United States and Canada, and a Data Coordinating Center to conduct a prospective epidemiological study of children with CKD. The primary goals of the Chronic Kidney Disease in Children Prospective Cohort Study (CKiD) are to

- determine the risk factors for decline in kidney function
- define how a progressive decline in kidney function affects neurocognitive function and behavior
- determine risk factors for cardiovascular disease
- assess growth failure and its associated morbidity

Read more about the CKiD, funded under National Institutes of Health (NIH) clinical trial number NCT00327860, at [www.statepi.jhsph.edu/ckid](http://www.statepi.jhsph.edu/ckid).

Clinical trials are research studies involving people. Clinical trials look at safe and effective new ways to prevent, detect, or treat disease. Researchers also use clinical trials to look at other aspects of care, such as improving the quality of life for people with chronic illnesses. To learn more about clinical trials, why they matter, and how to participate, visit the NIH Clinical Research Trials and You website at [www.nih.gov/health/clinical\\_trials](http://www.nih.gov/health/clinical_trials). For information about current studies, visit [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov).

## For More Information

### **American Association of Kidney Patients**

2701 North Rocky Point Drive, Suite 150

Tampa, FL 33607

Phone: 1-800-749-2257 or 813-636-8100

Fax: 813-636-8122

Email: [info@aakp.org](mailto:info@aakp.org)

Internet: [www.aakp.org](http://www.aakp.org)

### **American Kidney Fund**

11921 Rockville Pike, Suite 300

Rockville, MD 20852

Phone: 1-800-638-8299

Internet: [www.kidneyfund.org](http://www.kidneyfund.org)

### **American Society of Pediatric Nephrology**

3400 Research Forest Drive, Suite B-7

The Woodlands, TX 77381

Phone: 281-419-0052

Fax: 281-419-0082

Email: [info@aspneph.com](mailto:info@aspneph.com)

Internet: [www.aspneph.com](http://www.aspneph.com)

### **National Kidney Foundation**

30 East 33rd Street

New York, NY 10016-5337

Phone: 1-800-622-9010 or 212-889-2210

Fax: 212-689-9261

Internet: [www.kidney.org](http://www.kidney.org)

## Resources

### **Nemours KidsHealth Website**

*When Your Child Has a Chronic Kidney Disease*

[www.kidshealth.org/parent/medical/kidney/chronic\\_kidney\\_disease.html](http://www.kidshealth.org/parent/medical/kidney/chronic_kidney_disease.html)

### **Nephkids**

Cyber-support group

[www.cybernephrology.ualberta.ca/nephkids](http://www.cybernephrology.ualberta.ca/nephkids)

## Acknowledgments

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. The National Kidney and Urologic Diseases Information Clearinghouse would like to thank Barbara Fivush, M.D., and Kathy Jabs, M.D., of the American Society of Pediatric Nephrology (ASPN), for coordinating the review of the original version of this publication by the ASPN's Clinical Affairs Committee: Tej Mattoo, M.D.; William Primack, M.D.; Joseph Flynn, M.D.; Ira Davis, M.D.; Ann Guillott, M.D.; Steve Alexander, M.D.; Deborah Kees-Folts, M.D.; Alicia Neu, M.D.; Steve Wassner, M.D.; John Brandt, M.D.; and Manju Chandra, M.D. Frederick Kaskel, M.D., Ph.D., president, ASPN, and Sharon Andreoli, M.D., secretary-treasurer, ASPN, also provided comments and coordination of the original version.

## National Kidney Disease Education Program

3 Kidney Information Way  
Bethesda, MD 20892  
Phone: 1-866-4-KIDNEY (1-866-454-3639)  
TTY: 1-866-569-1162  
Fax: 301-402-8182  
Email: [nkdep@info.niddk.nih.gov](mailto:nkdep@info.niddk.nih.gov)  
Internet: [www.nkdep.nih.gov](http://www.nkdep.nih.gov)

The National Kidney Disease Education Program (NKDEP) is an initiative of the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, U.S. Department of Health and Human Services. The NKDEP aims to raise awareness of the seriousness of kidney disease, the importance of testing those at high risk, and the availability of treatment to prevent or slow kidney disease.

You may also find additional information about this topic by visiting MedlinePlus at [www.medlineplus.gov](http://www.medlineplus.gov).

This publication may contain information about medications and, when taken as prescribed, the conditions they treat. When prepared, this publication included the most current information available. For updates or for questions about any medications, contact the U.S. Food and Drug Administration toll-free at 1-888-INFO-FDA (1-888-463-6332) or visit [www.fda.gov](http://www.fda.gov). Consult your health care provider for more information.

# National Kidney and Urologic Diseases Information Clearinghouse

3 Information Way  
Bethesda, MD 20892-3580  
Phone: 1-800-891-5390  
TTY: 1-866-569-1162  
Fax: 703-738-4929  
Email: [nkudic@info.niddk.nih.gov](mailto:nkudic@info.niddk.nih.gov)  
Internet: [www.kidney.niddk.nih.gov](http://www.kidney.niddk.nih.gov)

The National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health of the U.S. Department of Health and Human Services. Established in 1987, the Clearinghouse provides information about diseases of the kidneys and urologic system to people with kidney and urologic disorders and to their families, health care professionals, and the public. The NKUDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about kidney and urologic diseases.

This publication is not copyrighted. The Clearinghouse encourages users of this publication to duplicate and distribute as many copies as desired.

This publication is available at  
[www.kidney.niddk.nih.gov](http://www.kidney.niddk.nih.gov).



National Institute of  
Diabetes and Digestive  
and Kidney Diseases

NIH Publication No. 14-4569  
August 2014

